IMPACT OF TRIMESTER-SPECIFIC NUTRITION LITERACY ON BIRTH OUTCOME OF MIGRANT PREGNANT WOMEN FROM URBAN SLUMS OF NCR-DELHI

SHORT SYNOPSIS

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Certificate

I hereby declare that the short synopsis titled '**Impact of Trimester-Specific Nutrition Literacy on Birth Outcome Of Migrant Pregnant Women From Urban Slums Of NCR-Delhi'** being submitted in partial fulfilment of the requirement for the degree of **Doctor of Philosophy in Nutrition** under the **Faculty of Allied Health Sciences,** of **Manav Rachna International Institute of Research And Studies, Faridabad** during the academic year 2020 - 2021.

It is a bonafide record of original work carried out under the supervision of **Dr Divya Sanghi** and has not been submitted in full or part to any other university or institute for degree or diploma.

Further, it is certified that short synopsis is plagiarism free and the proof has been submitted.

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ABSTRACT

Background: The foundation for human development is outlined by nutrition, particularly in the early stages of life starting from the pre-natal nutrition, that continues through first two years of life, childhood, and adulthood, thereby setting the developmental trajectory by improving cumulative lifetime learning capabilities and adult productivity.

Indian women are specifically vulnerable to the poor-health effects of under-nutrition, and reasons are multisectoral, not only due to their increased needs for nutritional requirements for child-bearing and rearing but also because of the greater likelihoods of living in poverty, lower levels of education and minimal rights in decision-making powers in the households and community. Reportedly, in India, 33% of reproductive-aged women are undernourished, with a less than 18.5 kg/m2 body mass index (BMI). Moreover, the nutrition in food generally remains low in-migrant households because of the low economic returns.

Method: The randomized, controlled intervention trial is exploring the low-cost, food-based trimester-specific approach through educating the 200 pregnant females of low-income households living in urban slums. The investigation will also validate the post-intervention impact on diet diversity in maternal nutrition. The Minimum Dietary Diversity-Women score (MDDW) will be calculated using the open recall method.

The study will also hypothesize that regular and consistent follow-ups can result in high adoption rates of the intervention by evaluating dietary intakes. The intervention end line assessment will evaluate the birth outcomes through anthropometric parameters of child and nutritional biochemistry profiles in the mother's blood and cord blood.

Results: The association between the variables of the two groups, study vs control will be analyzed using appropriate statistical methods and tools to uncover the findings of the study. The anthropometric, biological and social and demographical data will be examined using the SPSS (Version) for both the groups. The statistical significance of $P<0.05$ will be considered, with 80% power.

Conclusion: The study aims to answer the role of improving trimester-specific maternal nutrition thereby promoting healthy birth outcomes. Additionally, enhancing the knowledge levels during pregnancy for adequate and optimum nutrition intakes, play an important role in improving pregnancy outcomes.

Keywords: Nutrition, maternal and child health, diet diversity, nutrition-literacy, migrant population, food-based approach

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1. Introduction

1.1 Background of the study

Nutrition is the bedrock of a healthy state of body and the mind. Good nutrition builds the basis for human growth and development, by minimizing the vulnerability to infections, and their related diseases, disability, and in severe cases the mortality burden. Nutrition is essential for achieving good health, education, and economic objectives by enhancing cumulative lifetime learning abilities and adult productivity.

Human nutrition is the food intake and its utilisation in the body; therefore, it includes all that occurs from eating food to its usage in various functions of the body.

The science of nutrition deals with the various nutrients that are present in the food, the amounts we need in the proportion, and how these nutrients are got into the body, and how the body utilizes them. For proper utilization of these nutrients in the body, the right amount and the balanced proportion of nutrients are required and to achieve the highest quality of health, both physically and mentally.

The nutritional status of an individual depends upon what nutrients are consumed and what nutrients are utilized in the body. To meet the nutrition requirements, the diet components should be chosen judiciously to provide all the required nutrients in adequate amounts for the different physiological activities.

The nutrition requirements vary for different physiological groups for each individual depending upon body mass, age, gender, and physical status. The adults need good nutrition for the upkeep of health, to ensure proper body functions. Children up to two years of age require dense nutrient diets for healthy growth and development. Therefore, children require relatively additional nutrients per kilogram of body-weight than adults.

Any imbalance i.e., lack or excess of nutrition in the diet causes malnutrition (over or undernutrition). Under-nutrition is the state of inadequate consumption of essential nutrients in the body. Deficiencies of several micronutrients are common in India and other low, middle-income countries (Pathak P1, Kapil U, 2004).

The World Health Organisation estimated that about two-billion people currently were micronutrient-deficient, with women at greater risk owing to the physiological requirements such as menstruation and the high metabolic demands of pregnancy and lactation (World Health Organisation, 2000).

Additional nutrients are required for pregnant women to meet the increased needs for fetal development and expansion of maternal tissue and milk secretion during lactation. The additional intake of good and optimal nutrition is crucial for the standard growth of the fetus in the uterus and during early post-natal life, as per the Recommended Dietary Allowance for Indians (RDA), **2010 (National Institute of Nutrition, 2010)**.

The nutrition during pregnancy shall be monitored as it is an ideal period as it offers the opportunity to impact the health of both, the present and future generations.

Gender-related inequities in nutrition also tend to be inter-generationally entrenched, being passed on from mother to child.

Pre-conception health is strongly associated with the outcome of pregnancy, the preconception period is considered as the key determinant for health across generations **(Stephenson, 2018).**

Undernutrition levels have remained persistently high particularly in utero, in the early years of life, in adolescent girls and women across the life cycle, especially in-migrant disadvantaged community groups. Poor childhood nutrition has also been strongly linked with a range of long-term conditions, including stunting and impaired cognitive development. Nutrition status of the most vulnerable age group of children is also a profound proxy indicator of the effectiveness of national socio-economic development strategies **(National Nutrition Strategy (NNS), 2017).**

Several observational studies illustrate strong associations between pre-conception health and maternal and child health outcomes, with intergenerational transmission of health consequences. The optimal and adequate nutrition during pregnancy can improve maternal and perinatal outcomes by improving the Body Mass Index and related nutritional factors, including micronutrient deficiencies.

To measure the adult nutritional status of individuals and population the Body Mass Index, be used as a measure (BMI = weight in kg/(height in meters)^2) **(Bailey KV, 1995, WHO, 2017).**

1.2 Overview of prevalence

India ranked 102 out of the 117 qualifying countries listed in the Global Hunger Index for 2019. The country continues to grapple with a high rate of undernutrition and is under the "serious" category, with a GHI score of 30.3, and managing it remains to be an immense challenge **(Global Hunger Index, 2019).**

The epidemiological transition in India has not significantly impacted the reduction of burden due to maternal and child undernutrition in the country, despite concerted efforts by the government for providing adequate nutrition through the implemented several national programs namely, ICDS and other state-level supplementation programs **(McKeown, 2009).**

The NFHS-4 data indicates that the prevalence of stunting and underweight has declined among children up to five years of age; however, a soaring incidence of wasting is an emerging challenge, due to anaemia which remains the major public health problem in the country, besides, other micronutrient deficiencies **(NFHS – 4, 2019).**

According to the 14th edition of National Health Profile - 2019 of India, over half the children between 6 and 59 months (58.4 per cent) and women in the age group 18–49 are anaemic **(NHP, 2019).**

The anaemia is an ailment, in which the number and size of the red blood cells or haemoglobin, reduces below the established cut-off value, leading to the decreased oxygen-carrying capacity of the blood around the body leading to tissue hypoxia **(WHA - Anemia Policy Brief, 2012).** The physical characteristics of anaemia include greater vulnerability to infections, reduced individuals' well-being causing weakness and fatigue, low blood pressure, the lapse in concentration and confusion as well as nerve damage, including others.

Anaemia is an indicator of inadequate nutrition and poor health and has remained a significant public health concern as it leads to adverse impacts on the health of both women and children, two key groups that have high levels of anaemia, especially in low-income settings. Pregnancy and menstruation are commonly linked with anaemia in women. Maternal anaemia is linked with the risk of miscarriages, stillbirths, prematurity, and low birth weight babies including perinatal mortality and morbidity. The iron deficiency remains, the most common type of anaemia, and in

pregnancy with high fetal demands of iron, and other micronutrient deficiencies contribute to the poor health outcomes **(Lee, 2011).**

Iron deficiency often occurs in combination with other micronutrient deficiencies, including deficiencies of zinc, magnesium, selenium, and vitamins A, B-complex vitamins and C, D, E. Babies with uncorrected iron-deficiency anaemia have impaired development, both physically and neuro-cognitively, which makes them children with physical and learning problems. In infancy, iron deficiency is most often the result of lack of exclusive breastfeeding and the use of supplemented milk diets which contain inadequate amounts of iron.

Study Population & Participants

The increasing demand for daily wagers and labourer's in developing areas is met by the labourers from the backward and rural areas. The seasonal migration of smallholder farmers also contributes to the influx of mass flows from the areas of limited economic opportunities and hindered social development to peri-urban slums of the megacities to seek higher wages to improve their socio-economic status.

Population: Inter-state migrants account for more than 33% of the inhabitants in Delhi, widely considered a migrant magnet and patterns are asymmetrical in a statistical distribution on more than one count. According to the 2011 Census, Delhi shares the second-highest number of in-migrants to the state with 1.7 million in-migrants. Reportedly, men migrate for work and business which records for third of overall migrations, which is likewise the sole major reason for migration amongst men. According to a finding from the 2011 census, 97% of women moved from their last place of home because of marriage.

Participants: The prevalence of anaemia amongst the pregnant women in the study area is high, exceeding 50% caused by iron deficiency. The lack of this nutrient during the crucial first five years of life has intense and long-term adverse impacts, which extend long into adulthood, and in the case of women can have inter-generational effects on their children. Maternal nutrition has been viewed as a strategy to ensure an optimal nutritional environment for fetal development, with little attention to the benefits to mothers. Yet effective caregiving requires mothers

to be organized, flexible, responsive and knowledgeable about infant and child development characteristics that are at odds with depressive symptoms and the lethargy and lack of stamina associated with micronutrient deficiencies.

Thus, beyond the nutritional benefits to the fetus, enhancements to maternal mood, stamina, and cognition may enhance caregiving and mother-infant interaction, thereby providing additional benefits to early child development.

The regionally clustered nature of undernutrition particularly in vulnerable reproductive women in the study area and its determinants including diets and related factors are responsible for anaemia.

Factors of undernutrition

In urban slums, the households are mostly migrant populations and due to weak economic status, the nutrition in diets generally remains low. The association of household co-existence of maternal undernutrition and the regional prevalence of women undernutrition has hugely contributed to birth comes. Therefore, nutrition knowledge to increase daily energy and protein consumption is advised for reproductive-aged, pregnant and lactating females, to lessen the threat of low-birth-weight babies and a child's progression to developmental milestones.

The reproductive age women or women planning to bear a child, in particular, need diverse food items to meet the specific requirements of essential nutrients. The lack of diversity in food items is a major limitation among the migrants, where the starchy staples are significant diets and include insufficient or not any animal products and very low consumption of seasonal fruits and vegetables because of their economic conditions. Because of the low-income and purchasing influences, a big share of the migrant households subsists on food items or diets comprising majorly on the low-cost seasonal food items with low nutrient bio-availability.

The child-bearing women, need energy-rich and nutrient-dense diets to nurture the growing needs of a child to develop, both physically and mentally. The lack of adequate nutrition and responsive caregiving can undermine children's potential.

Several studies have suggested that an intensification in dietary diversity can increase nutrition adequacy of the diet and findings have been validated as proxy measures for nutrition optimization of the diet. Several trials findings suggested that during pregnancy, a mother's well-being and dietary habits can have a major influence on the growth, development, and imminent well-being of the new-born.

The low-socioeconomic status populations are commonly found with several nutrient deficiencies rather than single nutrient deficiency.

Few research findings suggest that the weight gain and pre-pregnancy BMI of expectant females influence the weight of their offspring, both in childhood and later in adolescent age, prompting a vicious cycle of malnutrition **(Kominiarek MA, Peaceman AM, 2017).**

Transforming food systems and addressing gender inequalities in consumption patterns, especially in low resource settings, is crucial to reduce anaemic rates and ensure that pregnant females have access to healthy and sustainable diets. Promotion of backyard kitchen gardens, awareness to consume nutritious foods, and ways to reduce the food waste should be advocated in communities.

Nutrition interventions have conventionally focused on the immediate or specific determinants of nutrition (e.g., dietary supplementation). Limited evidence is available from evaluations of associations between pregnant female nutrient status and birth outcomes in India.

Interventions designed to improve nutrition and health may ironically exacerbate local inequities with better-off groups benefiting more readily and sooner from intervention content and resources.

Therefore, there is a need to evaluate associations between nutrient concentrations in pregnancy and pregnancy outcomes. This may provide the opportunity of “personalizing” antenatal care to strata of pregnant females based on the food they eat. The results of the analyses will also lay a foundation for evidence-driven trials of nutrient interventions in pregnancy.

1.3 Aim of the study

The study aims to investigate the impact of trimester-specific nutritional counselling in pregnant women, and their correlation with clinical findings (anthropometric parameters and biochemical parameters) on birth outcomes.

2. Literature review

Villar J. and his associates (2003) evaluated the sufficiency of dietary nutritional interventions to turn away or treat preterm delivery and maternal morbidity and mortality. The study examined that the adverse birth outcomes are associated with the poor maternal nutritional status; however, the relationship between the maternal nutrition and birth outcomes are complex and are influenced by several other factors such as socioeconomic, demographic and biologic influences, which diverge generally in varied populations. The conclusions assumed that iron and folate supplements have reduced anaemia incidence and antenatal care programs must include the interventions. In pregnant women, calcium supplementation triggers the high risk of hypertension and reportedly low calcium intake decreased the incidence of both hypertension and preeclampsia. The use of fish oil and intake of vitamins C & E during pregnancy were found promising in preventing preeclampsia and preterm deliveries, however, this conclusion required further testing. Vitamin A and b-carotene decreased maternal mortality in this big clinical trial; however, the ongoing trials shall provide further validation assessments. There is no evidence of any other particular identified nutrient supplements in reducing preterm deliveries. The dietary and nutritional counselling for intakes of fish oil, magnesium, and zinc supplements gave promising results and shall be verified alone or together in methodologically comprehensive randomized controlled trials. The study results also suggested that pregnant women and their respective families should receive pyshco-social support to advance their dietary patterns for inclusive welfare.

Shonkoff JP, (2012), in his report, introduced an eco-bio-developmental approach that outlined about the timely and early encounters and environmental effects may leave an enduring mark on the genomic dispositions that may affect the developing brain architecture and enduring health. The report infers that there is a broad indication of the unruly impacts of toxic stress, presenting very captivating insights and patterns into causal mechanisms that are linked to premature adversities which may lead to impairments in learning, behaviour, and both physical and mental well-being and the origins of adult health and well-being, from the genomic-environment exchanges which starts from the first 1000 days of life (conception through 24 months).

Keats EC (2019), explored the advantages of Multiple-Micronutrient Supplementation (MMN) taken orally during pregnancy on maternal, fetal and infant health outcomes. The evaluation conclusions indicate the positive influence on birth outcomes of MMN supplementation when taken along with the iron and folic acid. MMN supplementations during pregnancy have reportedly prompted a decrease in low-birth and small for gestational age babies. Furthermore, the MMN supplementation presumably reduced the preterm deliveries. There were no other significant benefits or problems associated with MMN supplements. The study concluded that the additional folic acid and iron supplements along with the MMN supplementation for the pregnant women in low- and middle-income countries are highly beneficial for healthy birth outcomes.s

Devakumar D. (2016), reviewed the evidence from long-term follow-up studies from nine randomised controlled trials involving around 88,000 women beginning in the later first or second trimesters for multiple micronutrient supplementations. The intervention involved several micronutrients and the correlation group received an additional 60 mg of iron and 400 µg of folic acid, within permissible limits. The meta-analysis indicated that no variance in mortality rates where risk difference was -0.05 per 1000 live births and 95 % Confidence Interval, -5.25 to 5.15. The other six studies examined the anthropometric parameters and recorded no change at follow-ups in weight-for-age z score at 0.02; 95 % Confidence Interval, -0.03 to 0.07, height-for-age z score at 0.01; 95 % Confidence Interval, -0.04 to 0.06, or head circumference at 0.11 cm; 95 % Confidence Interval, -0.03 to 0.26. The study reported that presently there is no or limited evidence is available which compared the folic acid and iron supplementation with the routine maternal antenatal nutrient supplementation thereby improving the childhood survival, growth and development, body mass index or cognitive outcomes.

Hu, Zunsong et al. (2020), correlated the relationship between the dietary patterns of females during the pregnancy and the infant's early childhood growth and development trajectories with the obesity risk in offspring. Using the food frequency questionnaire, the maternal diets were evaluated for the second trimester, and the dietary patterns were summarised and concluded through rank regression. The

correlations analysis was done on 1257 pregnant females with data from the respective scores of their dietary patterns and body mass index (BMI) trajectories from the birth of offspring to age four (rising-high, moderate, and low BMI trajectories) also obesity risk at the age of four were analysed. The two maternal dietary patterns were recognized and established in the population. The junk-food pattern included a massive consumption of deep-fried food items which include chicken, prawns and fish, cheese, canned fruit juices, and sugared beverages, while the managed food pattern included an augmented intake of dairy products, mixed greens dressings, cold breakfast cereals, and processed meat. The pregnant women with more likeliness to the junk foods were found to have offspring with the high BMI trajectory group that is 95% Confidence Interval = 1.32 (1.07–1.62); p = 0.008; or bearing obesity by the age of four or 95% Confidence Interval = 1.31 (1.11–1.54); p = 0.001.

The processed food likeliness was not related to the aforementioned conclusions. The study concluded that the rapid early childhood growth and development and increased risk for obesity in offspring maybe because of the dietary pattern represented by the intake of deep-fried foods and sweetened drinks and beverages of the pregnant females.

Ambike (2018), explored the impact of association of maternal nutrition, socio-economic influences and education levels on the birth weight of the offspring in 250 mothers in Pune Maharashtra. The average birth weight of offspring documented was 2.65 kilograms with the lowest birth weight of 1.2 kilograms while the maximum birth weight of 4 kilograms. However, the 27.6% incidence of Low-Birth Weight babies was reported. The study reported that 77.2% of pregnant women had caloric intake less than 1800 Kcal, a protein intake of fewer than 45 grams in 80% of females. Almost, 31.60% of the pregnant women delivered Low-Birth Weight infants, who were also taking daily recommended intake of calories i.e., less than 1800 Kcal. About 30.50% of the pregnant women delivered Low-Birth Weight babies with protein intake less than 45 grams/ day. Altogether 34.86% of the pregnant females delivered LBW babies with a haemoglobin level below 11 grams. The study findings were statistically substantial.

The study concluded that during the pregnancy, caloric and protein deficiencies with iron deficiency had a major effect on the birth weight of babies, as malnourished

females delivered higher percentage of Low Birth Weight babies, in comparison with the females who were moderately or adequately nourished.
Also, a female's education and socioeconomic statuses influenced the birth weight of new-borns.

Johri (2015), researched whether maternal health knowledge, is a swiftly changeable factor related to mother's education, as related to immunization of children in two underprivileged Indian communities. The group investigated the maternal health knowledge using child-health promotion resources, through multivariate logistic regression to investigate the relationship between maternal health literacy and immunization rates independently in two, urban sites from nine slum clusters which included 670 women and rural sites from 60 villages involving 1170 women. Site-specific, models were adjusted that revealed an encouraging relationship between maternal health knowledge and DTP3. In the rural location, the adjusted odds ratio was 1.57 with 95% Confidence Interval,1.11 to 2.21, p=0.010) for those with medium health knowledge, and odd ratio =1.30 with 95% Confidence Interval 0.89 to 1.91, p=0.172) for those with high health knowledge. The urban site indicated the adjusted Odd Ratio of 1.10 with 95% Confidence Interval, 0.65 to 1.88, p=0.705, for individuals with average health knowledge, and Odd Ratio=2.06 with 95% Confidence Interval 1.06 to 3.99, p=0.032) for individuals with good health knowledge. The study findings inferred that in the two intervention settings, maternal health knowledge is independently related to childhood immunization. The government-led programmes will help to target health knowledge that would improve immunization coverage.

Gennings (2020), and his research group utilised an established nutrition guide, 'My Nutrition Index', that gauges the appropriateness of individuals diet regime in comparison with the exceptional dietary needs of persons due to their physical activity level, dietary limitations, lifestyle, and body mass index. The structured pre-natal Food Frequency Questionnaire was used to record an individual's micro-nutrient index. The nutrition index was fundamentally and conclusively connected with an important metabolic outcome, as measured by the birth weight and cognitive function at age 7 years, as measured by WISC IQ in the children, with adjustments for covariates and pre-natal concentrations of endocrine-disrupting

chemicals. The stratification of data was done on ‘less’ and ‘high’ consumption of fish, as a likely origin of Perfluorooctanesulfonic acid or PFOS. The correlation between the PFOS and birth weight indicated the reduction in the high consumption arm associated with the low intake set. The conclusive results and findings infer that the ‘My Nutrition Index’ can be considered as a set metric of the overall nutrition of the daily meals and can be useful in health-environment studies during the pregnancy in depicting the influence of adequate and optimum nutrition.

Kaseva (2020), investigated the correlation of Gestational diabetes mellitus (*GDM) and* (body mass index (BMI) $\geq 25\ kg/m^2$) *or* maternal pre-pregnancy overweight are related with nutrition quality or intakes in adult offspring. The study findings indicate that the carbohydrate intake, if higher than recommended daily allowances in male babies were exposed to maternal pre-pregnancy obesity as in comparison with the control group. The relationship of the adult offspring dietary intakes could not be associated with prenatal exposure to GDM.

Kominiarek (2017), studied the correlation between the increase in weight and the associated risks of not putting on enough weight, including approaches to health behaviour management to attain optimal weight increase in pregnancy. The finding infers that the Gestational Weight Gain (GWG) continues to be a complicated, yet vital variable in prenatal care approaches particularly for few changeable determinant conditions for adverse perinatal issues and abnormalities run into possible influence on the short-term and long-term effect on health for both the mother and child. As specified, the growing incidence and adverse significances of uneven GWGs, averting excessive GWGs is becoming gradually significant for primary care providers. The study concluded that upcoming trials concerning gestational weight gain should include psycho-social determinants and parameters of gestational weight gain sideways by the generally estimated nutrition and physical activity variables. The strategy of healthcare behaviour change interventions for obese females warrants larger emphasis on their design content and dissemination timing to ameliorate gestational weight gain and other related consequences in the females and their neonates.

3. Description of the broad area

3.1 Context:

Pregnancy is a period of explicit nutritional requirements for sustaining the health of both the mother and the fetus. The nutrition needs of the households vary from each other, depending on the belonging of state and their traditional and staple diets.

Of particular interest is the identification of and distinction between problem nutrients (i.e. those nutrients that cannot be met by locally available foods) and problem behaviours (i.e. those behaviours which affect consumption of locally available nutritious foods due to economic and socio-cultural reasons).

Local foods in this context include food that is available in low-income communities; food that is regularly bought or procured through trade; and food that is available through local markets.

To disseminate the knowledge about nutrition-sensitive food consumption practices, it is necessary to recognize the current local food systems and their relationship to nutrient availability and maternal food consumption patterns.

3.2 Prenatal nutrition requirements:

The pregnant women are generally advised to eat diverse food items to ensure that the requisite nutritional necessities for fetal growth are achieved. However, there a specific obligation to alter their conventional dietary pattern is not required. However, the portion size, diversity, and occurrence of usage of the diverse food items shall be augmented.

The optimum and adequate consumption of a nutrient-rich diet may help accomplish the optimum weight gain i.e., (8-14 kg) by the expectant female, during pregnancy**.**

Table 1: Gestational weight gain proposed recommendations

Prenatal period BMI	**Total weight gain at the term**	**The proportion of weight gain in the 2nd and 3rd trimester; Mean (range)**
Underweight (<18.5 kg/m^2)	12.5 -18.0 kilograms	0.51 (0.44 - 0.58) kg / week

Standard weight (18.5 - 24.9 kg/m^2)	11.5 – 16.0 kilograms	0.42 (0.35 - 0.50) kg/week
Overweight (25.0-29.9 kg/m^2)	7 - 11.5 kilograms	0.28 (0.23 - 0.33) kg/week
Obesity (≥ 30.0 kg/m^2)	5.0 – 9.0 kilograms	0.22 (0.17 - 0.27) kg/week
*Source Data from the Institute of Medicine. Weight gain during pregnancy: re-examining the guidelines. Washington, DC: Institute of Medicine; 2009.		

The daily dietary recommendations for a pregnant women diet through the first trimester should exclusively comprise an added 350 calories, 0.5 grams of protein and during the second trimester the protein intake should be increased to 6.9 g and during the third trimester of pregnancy, the adequate protein should be 22.7 g, as per National Institute of Nutrition.

Moreover, to sustain the aforementioned dietary requirements, the pregnant female should undertake regular monthly health check-ups for blood pressure, optimal weight gain, ultrasounds and take tetanus toxoid vaccine**.**

3.3 Macronutrients & Micronutrients functions and requirements in pregnancy:

→ Iron is an essential element of blood production which makes haemoglobin, a protein in red blood cells for transferring oxygen to tissues and is required to meet the high demands needed for the development of red blood cells. During pregnancy, the amount of blood in the body increases, therefore iron is needed in higher amounts to sustain foetal blood supply. As per ICMR, recommendary daily allowance for Indian pregnant female is 35 micrograms/day of iron during the pregnancy condition.

→ Protein aids in fetus tissue growth and also help in the development of muscles, and blood during pregnancy. The daily diet of pregnant women daily should include an additional protein of 0.5 grams throughout the first trimester, 6.9 grams proteins through the second trimester and 22.7 grams of proteins during the third trimester, therefore, total proteins of about 78g during the third trimester.

→ DHA requirements during pregnancy are 200 to 300 mg per day and are required for the baby’s brain growth and development and reduce the preterm birth risks.

→ Folic acid is also known as folate and is a form of vitamin B9. Folic acid is essential for preventing the certain neural tube defects (NTD), which is the main birth defect of child's brain (anencephaly) or spine (spina bifida) and also help in increasing the birth weight. Folic acid intake also helps make normal red blood cells during pregnancy and aids in production, repair the functioning of DNA, genetics. The recommended daily allowance during pregnancy is 500 micrograms/day, which is recommended to be continued as long as breastfeeding.

→ Vitamin A is required to support the pregnant female metabolism, immune function, healthy vision, and also supports the foetal growth and tissue maintenance. The daily intake recommended dietary allowance of Vitamin A is 800µg of or 6400µg of beta carotene.

→ Vitamin C plays a critical role throughout pregnancy in the synthesis of collagen, which is an important structural protein that provides structure to cartilage, tendons, bones and skin, as well as helping your body to fight infections. Vitamin C is also needed for wound healing and helps develop fetus teeth and bones. Vitamin C also aids in the absorption of iron by reducing ferric to ferrous state in the gut.

→ Fat supports the fetus brain and eye development and also aids in placenta growth and tissue growth. The poly-unsaturated fatty acids (PUFAs) aids in fetal brain development, nervous system, and retina development. Adequate intake amount of fats also helps in preventing pre-term births and low birth weight babies.

→ Calcium is a critical mineral which contributes to the development of fetus heart, bones, teeth, muscles, and nerve function and also averts osteoporosis ailment in the female at later stages. Calcium is also needed for fluid control. The ICMR has recommended the dietary allowance for the daily intake of the calcium requirement for pregnant female at 1200 micrograms.

→ Iodine helps fetus brain development and particularly the central nervous system. The recommended daily intake of iodine is 220 micrograms. The iodine intake for pregnant women is recommended to be increased by 50% to produce adequate thyroid hormones to meet fetal requirements.

3.4 Food safety during pregnancy:

→ Food safety during pregnancy is paramount and to prevent several food-borne allergies or illnesses from harmful bacteria & parasites in foods, which can harm fetus even if pregnant women don't feel well.

→ Eating un-cooked sea-food, under-cooked eggs, undercooked meat & poultry should be avoided, as they can cause listeria which may cause abortion /miscarriage, premature or early birth resulting in low birth weight babies and some cases, even death of the infant.

→ Substance abuse or drinking alcohol during pregnancy may cause the fetus to have Fetal Alcohol Syndrome (FAS), which may result in brain damage and growth problems in a child.

3.5 Definitions:

ASHA (Accredited Social Health Activist)

ASHAs are the married educated regional women and are voluntary health workers trained to work in their communities and act as machinery to implement various government-run health programmes. For every 1000 population, there is one ASHA who are incentivised as applicable. ASHA's facilitates and encourages, the women to have healthcare institutional deliveries and children immunization.

The ASHAs mobilise within the community and create awareness on family planning, treatment of basic illnesses and injuries with first aid, document demographic records, and improving village sanitation.

ASHAs also counsel women on birth awareness, the importance of safe health institutional delivery, and promotes breastfeeding and complementary feeding, and care of the neonates, infants and young children.

Auxiliary Nurse/ Midwives (ANMs)

Auxiliary Nurse/ Midwives (ANM) are based at the primary healthcare facilities. The ANMs are male/female multipurpose health workers with the responsibility to aid ASHAs & AWWs. ANMs manage routine immunization to children and antenatal care. Any treatment taken from the ANM during their community visits is considered as medication done at the healthcare centre.

National Health Dispensary

The National Health Dispensary is a civic institution and is the most common provider of health services where the basic medical aids are supplied, and treatments are dispensed. The dispensaries staffed by few doctors, and aid all centrally funded healthcare schemes.

Pre-natal care under national guidelines

Pre-natal care is important and a type of preventive healthcare which involves regular health check-ups during pregnancy to avert and medicate the possible health complications through the span of the prenatal period for the health of mother and fetus.

Pre-natal care usually includes medical history, followed by the physical examination of the woman, anthropometry parameters, haemoglobin test for diagnosing anaemia, blood pressure records and regular ultrasounds for abdominal examinations, etc. Immunisation of pregnant women with Tetanus Toxoid (TT) is done in the first trimester and regular Iron/Folic Acid tablets or other prescribed vitamins as needed, along with any required treatment in case of any complication.

At least 4 check-ups are advised during pregnancy, first prenatal care examination shall be done within 12 weeks with complete physical, systemic and abdominal check-up, the successive check-up during 14 - 26 weeks, the successive third examination during the 28 - 34 weeks and the final fourth periodic check-up between 36 - 40 weeks.

Slum - A slum is highly populated, the dense area with poorly built congested tenements and housing units, lacking in proper or reliable sanitation and clean water facilities and with minimal law enforcement and other basic services **(Census Data, 2001).**

Anthropometric Measures

Anthropometry is the measurement of the human individual. Many datasets contain anthropometric measures of children at different ages to monitor growth over time and to compare the measurements to growth standards of healthy populations. Some of the most common measurements include:

- **Height**: standing height, taken for children 2 years or older, typically measured in centimetres.
- **Length**: recumbent length, taken for children ≤2 years of age, typically measured in centimetres. Short height/length measurements concerning age against a healthy population can be indicative of stunted growth.
- **Weight**: typically measured in kilograms. Low weight measurements are indicative of wasting.
- **Head circumference**: typically measured in kilograms. Slow head growth can be a result of severe undernutrition.
- **BMI**: Body Mass Index (BMI) is a consistent measure of the height and the weight of an adult individual for measuring body fatness. It is interpreted through weight divided by the square of the height and is quantified in units of kilograms/meter^2.
- **MUAC**: The Mid-Upper Arm Circumference (MUAC) is calculated by the circumference measure in centimetres of the muscle mass of the left upper arm, and is an anthropometric indicator for nutritional assessment.

Anthropometric Growth Standards and Associated Measures

Growth standards are used to provide an indication of how a child is growing relative to a healthy population and provide a statistical distribution against which an anthropometric measure can be compared. Growth standards are used to indicate what percentile of the distribution a child's measurement falls into or are used to report a standardized Z-score of the measurement. Most growth standard measures are devised on the child's age and sex (the distribution is different for different age and sex).

The most commonly-used growth standards for newborns and children are devised by the World Health Organization (WHO) and the International Fetal and Newborn Growth Consortium for the 21st Century (INTERGROWTH). The guidelines of INTERGROWTH provide additional standard protocols for preterm and premature preterm children and also provides growth standards for prenatal anthropometry that is measured through ultrasound with measures such as femur length, biparietal diameter, occipital-frontal diameter, and abdominal circumference.

Some of the most commonly-used measures based on growth standards are:

- **HAZ**: Height for Age Z scores for boys and girls

- **LAZ**: Length for Age Z scores for boys and girls
- **WAZ**: Weight for Age Z scores for boys and girls
- **WHZ**: Weight for Height Z scores for boys and girls

An open-source R package, growth standards can be used to compute against the WHO and INTERGROWTH standards.

Terms Related to Growth

→ **Gestational age**: The timeframe between conception and birth is referred to as gestation. Inside the mother's uterus, fetal growth and development are measured. The gestational age is a key and basic term used during pregnancy to define the pregnancy period. It is typically estimated in weeks, from the initial day of the woman's last menstrual period. A normal full-term pregnancy has gestational age ranging from 38 - 42 weeks, whereas infants that are born in 39 - 40 weeks are generally considered to have the best chance of being healthy. However, the infants born before 37 weeks are considered to pre-term babies and the infants born after the 42 weeks are considered postmature babies.

→ **Preterm birth:** A pre-term birth is when a fetus is born alive early that is, less than 37 weeks of pregnancy. Preterm birth is also one of the causal factors in stunted growth and development.

According to the **Preterm Birth, WHO factsheet**, based on gestational age, the preterm birth has been categorised in the following:

* *the babies born before or less than 28 weeks of pregnancy are **extreme preterm births;***
* *the babies born between 28 weeks and 32 weeks of pregnancy are **very preterm births**;*
* *the babies born between 32 weeks and 37 weeks of pregnancy are **moderate to late preterm births**.*

→ **Small for Gestational Age:** The Small for Gestational Age (SGA) is denoted to outline those new-borns who are smaller than usual or normal size for the gestational age. The new-borns have a birth weight less than the 10^{th} percentile for the gestational age.

→ **Growth faltering:** Slower than normal development between two-time points

→ **Normal development:** Development of a child in "optimal conditions".

→ **Stunting:** Stunting is referred to the impaired growth and development resulting in shortening of the height and is often caused due to inadequate nutrition of

mother or recurrent infections. The stunting is defined by height-for-age HAZ < -2, recorded as more than two standard deviations below the Child Growth Standards median defined by WHO. The moderate stunting is defined by -3 < HAZ < -2, and severe stunting is defined by HAZ < -3 as per the standard child growth medians.

The stunting may cause irreversible physical and mental damage to the children. Stunting is also indicative of poor growth and development of a child.

→ **Wasting:** Wasting is referring to the losses in fat and muscle tissues due to disease or acute or chronic malnutrition. Wasting is typically categorized based on the Weight for Height Z scores (WHZ), by WHZ < -2 indicating wasting and WLZ < -3 indicating severe wasting. MUAC can also be used, with MUAC < 12.5 cm indicating wasting and MUAC < 11 cm indicating severe wasting.

→ **Undernutrition:** Undernutrition is a deficiency of essential nutrients and is defined as the outcome of insufficient calories intake and recurrent infections or a disorder which doesn't absorb food. Undernutrition is determined by several indicators that include the underweight individuals, short height, very low body fat or very thin and deficiency-related problems.

→ **Low birth weight (LBW):** Low-birth weight is used to define new-borns who are born weighing less than 2,500 grams. Low birth weight babies may have several health problems.

→ **Severe acute malnutrition (SAM):** The Severe Acute Malnutrition is defined by weight for height/ length z scores (below -3 WHZ scores of the median as mentioned in WHO growth standards), typically by MUAC <11.5, by visible severe wasting, or by the presence of nutritional oedema.

→ **Intrauterine growth restriction (IUGR):** IUGR has referred to an irregular restriction of fetus growth and development and the condition affects the overall size of the fetus and leads to fetal malformation and chromosomal or metabolism abnormalities. IUGR babies have a birth weight less than the 10^{th} percentile for the gestational age, which means babies are smaller than many other neonates of the same gestational age.

4. Objectives of the study

4.1 Objectives

1. To identify migrant pregnant women (first trimester) residing in urban slums.
2. To assess the dietary intakes, anthropometric variables and biochemical parameters of migrant pregnant women.
3. To develop the low-cost optimized trimester specific IEC material for providing nutrition literacy
4. To intervene the low-cost optimized trimester-specific nutrition literacy among participants
5. To assess the pregnancy outcome (anthropometric, biochemical and gut microbiome of new born) of the participants
6. To correlate the anthropometric variables, biochemical parameters and dietary intake of participants with pregnancy outcome.

4.2 Hypothesis

Alternate Hypothesis

The trimester-specific nutrition knowledge for a balanced diet of a migrant pregnant woman are associated with substantial improvement in pregnancy outcomes.

Null Hypothesis

The trimester-specific nutrition knowledge for a balanced diet of migrant pregnant women are **not** associated with substantial improvement in pregnancy outcomes.

1. Methodology to be adopted

5.1 Study Design

This study will be an individually randomised control study design. The design will enable us to examine the impact of the timing of trimester-specific intervention delivery.

This study will recruit migrant pregnant women from urban slums, who report pregnancy as early as twelve weeks. For the control group, migrant pregnant females of a similar number will be recruited under the study.

The migrant pregnant females will be recruited through ANM and ASHA workers under, National Health Dispensary, Okhla, New Delhi from the migrant population in urban slums. The pregnancy confirmation will be through the Gynaecologists at the dispensary.

5.2 Research Setting or Locale of the study

This study will be conducted in the urban slums of Okhla, South Delhi.

Delhi has received the highest number of migrants from other states in their population. Alone in terms of the proportion of in-migrants, three districts South-West, South and New Delhi constitute 40% share of the interterritorial migrants of the current entire population. Concerning Central Delhi, the share is just 17% reason, the walls among the oldest inhabitations.

In 2011, practically 50% of the in-migrants were received in Delhi, were from Uttar Pradesh (West), Jharkhand, West Bengal, Bihar, Odisha and Uttarakhand which has expanded reliably somewhere in the range 1991 and 2011 **(Census, 2011).** Therefore, in 2011, more than 66% of Delhi's in-migrant population came from the aforementioned states. Bihar and Haryana states contribute the highest percentage of the migrants to Delhi's total population.

This migrant population lives in the Jhuggi-Jhopdi (JJ) or re-settlement clusters, slums designated areas, un-authorized colonies etc. because of their socio-economic status and affordability.

5.3 Target Population

Subjects will be migrant pregnant women from other states of India, who report the pregnancy to the ASHA/ANMs at weeks of their gestation.

5.4 Sampling method

The sampling frame will be selected from the regional community health centres, and the samples are planned to be selected by **Purposive Sampling** calculation method to recruit subjects of the study.

5.5 Sample size

The sample of 200 would be taken as this is a randomized control trial-based study. Among the women of the reproductive stage, the prevalence of anaemia in Southern Delhi is 58.6% **(International Food Policy Research Institute (IFPRI), 2017)**

→ Error – 10%

→ Confidence – 95%

The sample size of 200 will be included in the study as computed by the **Purposive Sampling** calculation method. Mean values and standard deviation were calculated, mean difference from empirical research taking a 5% level of significance with 80% power.

→ An attrition rate of 20% would be taken into consideration.

→ The randomization will be done the basis of reported chronic illness and healthy pregnancy.

→ The subjects will be selected based on the inclusion and exclusion criteria.

5.6 Selection Criteria

Pregnant women living in low-income households, who report the pregnancy to ASHA/ANM frontline workers will have consented and who express interest in the study will be enrolled, following the ethical procedures. They will be advised of the protocol and that they may withdraw at any time. Informed consent will be obtained and an initial evaluation, including blood draw and anthropometries, will be conducted. Randomization will be done based on reported chronic illness and healthy pregnancy.

I. Inclusion Criteria

i. Married nulliparous women aged 18-35 years from other states

ii. Living with husbands

iii. Pregnant women without any health complication or chronic illness
iv. Not following any special or specific diet
v. Plan to remain in the community for delivery
vi. Ready to participate in this study by signing an informed consent

II. Exclusion Criteria

i. Pregnant women with health complications or any chronic illness
ii. History of any trauma
iii. Severe undernutrition – BMI <18
iv. Severe anaemia (haemoglobin [Hb]<8),
v. Multiple gestations
vi. Any condition that could interfere with caring for an infant (e.g., severe disability or mental illness).
vii. Unwilling women who are unable to give consent

5.7 Consent for recruitment into the study

The purpose, methodology and detailed experimental plan will be explained, and the pregnant females who are willing to participate in the research study will be requested to sign an informed consent form before the study.

5.8 Ethical approval

Ethical approvals will be taken for study implementation. The approval for this study will be taken from the MRIIRS Institutional Ethical Review Committee.

5.9 Tools & Techniques:

1. A set of 'Questionnaire' is formulated to collect information on demographic profile, health and nutrition status and socio-economic condition etc.
2. Anthropometric measures for pregnant women will be done, which includes weight and height.
3. The Minimum Dietary Diversity for Women (MDD-W) questionnaire will be adopted to measure diet diversity and intake of micronutrient adequacy, key dimensions of diet quality.
4. Quantitative data will be collected for dietary assessment by 24-hour recall method.

5. Quantitative analysis will be done for biochemical, haematological and anthropometric measurements.

5.10 Data Collection

→ Women's height and weight will be obtained from data obtained at the first antenatal care visit.

→ An ethnographic longitudinal follow-up - a before and after nutrition Knowledge, Attitude and Practices (KAP) survey of mothers, which will also include anthropometric measurements and information on a demographic, household, maternal and child characteristics.

→ Administration of the MDD-W survey inquiry form through a structured 24-hour open recall dietary questionnaire of pregnant women.

5.11Questionnaire

The study will administer the mixed survey questionnaire (MDD-W and HDDS) in 200 study participants (migrant pregnant women) which will be interviewed individually.

i. Minimum Dietary Diversity for Women (MDD-W)

The Minimum Dietary Diversity for Women (MDD-W) index has been designed by the Food and Agriculture Organization (FAO), United Nations which accomplices to substitute the requirement for a basic, food-based standard for estimating the diet diversity and micronutrient intake adequacy along with the crucial proportions of diet quality **(FAO, 2016).** The survey includes the recording of the consumption of no less than 5 (*minimum threshold*) out of 10 pre-defined food groups by the reproductive age women, in the past 24 hours is evaluated, and whichever is related with the complex chance of appropriateness for other 11 micronutrients. The MDD-W survey is essentially collected by using any one of the two qualitative dietary assessment methods i.e., **open recall** or **list-based** questions.

In July 2020, the MDD-W model has been recognised in the **State of Food Security and Nutrition in the World (SOFI)**, which is an annual flagship report, which provided in-depth analysis on nutrition published jointly by the FAO, IFAD, UNICEF, WFP and WHO.

ii. Household Dietary Diversity Score (HDDS)

The Household Dietary Diversity questionnaire characterizes a rapid, simple, convenient and efficiently administered low-cost calculation tool. The recording and in-depth investigation of the evidence gathered with the survey questionnaire is candid. The household dietary diversity score described in the rules and guidelines involves a simple count of food groups that a household has eaten over the last 24 hours. The guidelines also detail the utilization of the dietary diversity questionnaire at the household or the family level. The collected data and information can also be investigated to evaluate the evidence on detailed food groups of interest.

The Household Dietary Diversity Score (HDDS) is intended to consider, in a dashboard frame, the **economic capacity** of the household to afford the diversity of foods. Several pieces of research have demonstrated that augmentation and improvement in dietary diversity are linked with household food security and socio-economic status **(Hoddinot and Yohannes, 2002; Hatloy et al., 2000).**

5.12 Information, Education and Communication (IEC) materials

IEC materials (Pictorial flyers and PLA videos) will be developed and will be introduced during in-person interactions, in presence of ASHA for wider acceptability and lesser hesitancy.

5.13 Data Analysis & Results

The parameters clinical, biochemical parameters will be correlated with socioeconomic, demographic and other related maternal characteristics, to evaluate whether the trimester-specific nutrition awareness has a substantial effect on the pregnant women, especially weight of the new-born.

The collected data will be dealt with the help of MS Excel and SPSS and primary and higher-order statistical methods will be applied as per the requirement of research objectives.

Linear Mixed Model (LMM) for the continuous outcome variable (household and demographic characteristics) and Generalised LMM for the categorical outcome

variables (Infants serum ferritin) will be performed to assess the effect of the intervention.

Pearson's correlation coefficients will be used to analyse the survey baseline and impact assessment results.

5.13 Conclusion

The pilot study will test by improving knowledge low-cost food-based approach, focusing on the necessity of improving diets (including the availability of nutri-rich food, dietary diversification) in both quantity and quality to overcome and prevent undernourishment and its impact on the pregnant women.

The study will also postulate that regular follow-ups result in high adoption rates of the intervention.

The study will also assess the degree to which the effect of the interventions might vary based on confounding variables related to households, socio-economic status, network, and community-level characteristics.

Even though not anticipating the effect of the intervention on the behavioural outcome to be mediated by nutrition knowledge, considering the feasibility to include their measurement as a potential confounder.

5.14 Study Progression Flow

Based on the data from the **Demographic and Health Survey (DHS) of India (2005-2006)** and the **(National Family Health Survey - 4, International Institute for Population Sciences, 2015)** the median age of marriage for women is 17.2 years and the median age at first birth is 19.1 years. Within 2 years of marriage, greater than 50% of women are likely to give birth.

i. Intervention Design

The design is to impart trimester-specific packages of nutrition knowledge to study participants in presence of ANMs and ASHAs as antenatal care is delivered by the Auxiliary Nurse Midwives (ANMs) and the Accredited Social Health Activists (ASHAs). The presence with health services will be easier too as acceptability of intervention and reliability will be more.

The design focuses on the **timing** of nutrition literacy as an enhancement to the standard of pregnancy care provided to pregnant women.

The **randomized controlled study**, where women are randomized into two groups: A & B. The study will consist of the group (Group A and Group B).

Table 2: Study Group

Group A (Experimental Group)	Group B (Non-Experimental Group)
Pregnant women, with no health complications, who will receive the intervention, will also receive the standard of pregnancy care (SPC) through the national programme	Pregnant women, with no health complications, who will receive the standard of pregnancy care (SPC) through the national programme

This design will enable to investigate the impact with the **timing** of knowledge impartation to determine whether there are beneficial effects of adequate dietary intakes in birth outcomes. The outcome of the study will generate evidence-based data regarding the role of prenatal nutrition knowledge in birth outcomes.

The study is aiming to design a trimester-specific intervention package to target the linkages of nutrition-health convergence.

The study will adapt knowledge dissemination through teleconsultation, to test the timing of trimester-specific nutrition packages as an enhancement to the Standard of Pregnancy Care (SPC) provided to pregnant women along with standard care of national programmes (a daily supplement of 100 mg iron and 500 µg Calcium) from approximately the 12^{th} week of pregnancy through 100 days post-delivery).

The nutrition counselling has been an extensively used approach to improve maternal nutritional status. The intervention will be promoting appropriate, and optimal nutrition of the precise amount of nutrients at the right point of time. The intervention will also advocate and administer the nutrition literacy to pregnant women to lessen the burden of underweight babies and anaemia in the pregnancy.

The delivery of the intervention and SPC will occur simultaneously and will be monitored through tele/video consultations, in coordination with local ASHAs and ANMs.

Nourishment advising has been a broadly utilized methodology to improve the dietary status of ladies during pregnancy.

ii. Intervention Layout:

First Semester:

- → Vitamin B6: The treatment for early pregnancy nausea and vomiting, which generally starts by the fourth week of pregnancy, 40 mg of vitamin B6 tablets has effectively demonstrated to be a viable **(Fatemeh Sharifzadeh, 2018).**
- → Vitamin E, low on vitamin E status and increased miscarriage risk **(Abu Ahmed Shamim, 2015).**
- → There is some evidence that adequate intake of calcium may reduce the risk of pre-eclampsia **(WHO, 2013**)

Second Trimester:

Hunger and constipation are common this trimester. Water intake and small portions of food a small interval will help.

The augmented intake of protein during pregnancy, particularly during the second and the successive trimester to confirm requisite intake of 21 grams additional

protein required for maternal health, placenta and fetal tissues as recommended by the international guidelines. **(Trumbo P., 2002).**

Third Trimester:

→ **Heartburn**: Also called acid indigestion, caused due to enlarging of the uterus during pregnancy. It is common because of changing hormone levels, causing acid to creep up the oesophagus.

→ Pregnant females are also prone to deficiency of Vitamin A generally during the third trimester because of the rapid fetal growth and development with the rise in the blood volume of the fetus and pregnant female.

→ Few studies suggested that the **dates** consumption in the third trimester of the pregnancy is to be considered safe as it reduced the need for labour intervention without any adverse effect on the mother and child.

→ **Caregiving Behaviour:** The knowledge of Kangaroo Mother Care, mother-infant interactions and exclusive breastfeeding will be given to the recruited women in the third trimester.

Table 3: Trimester-specific nutrition diet counselling chart

Nutrient(s)	Function	Food sources
First Trimester		
Folic Acid (Vitamin B9)	Protects against anaemia and other infections, and helps in the brain and skull development, and aid in the growth of the spinal cord of the growing fetus	Nuts: groundnut seeds, roasted chana Vegetables: dark green leafy vegetables, for eg. spinach, okra beans, peas, cabbage, spring greens, kale, and baked potatoes, corn, Fruits: papaya, oranges Legumes: chickpeas, rajma and lentils asparagus and fresh peas
**Folic acid is usually lost during cooking, so it is recommended to steam vegetables or to cook in minimal water for a short period.*		

Vitamin A	Maintain epithelial tissues and cells Normal development of teeth and bones	Vegetables: tomatoes, cabbage, pumpkins, carrots Non-veg: liver, kidney Dairy Products: egg yolk, milk, butter and cheese, cream. Fruits: mangoes, papaya
Vitamin C	Aids in wound healing and assist in iron absorption	Fruits: Citrus fruits for eg. oranges, lemons, Malta and other yellow pulp fruits like papaya, grapefruits, grapes, berries, kiwi, pineapple and guavas Vegetables: tomatoes, cabbage, spinach, carrots, potatoes, bell pepper, tomatoes, coriander leaves
Vitamin D	Supports in the acclimatization of calcium and helps in the accumulation of calcium salts in a fetus skeleton tissue	Sunlight Dairy: eggs yolk, cow milk, butter, Non-veg: fish, fortified oils Vegetables: Mushroom
Magnesium	Supports in biochemical reactions, and helps in muscle and nerve functioning, and, aids in strong bones and boosts immunity.	Vegetable: Beans, vegetables serve as good sources of magnesium. Nuts: nuts, whole grains and green, dried coconut

Selenium	an important antioxidant which helps in the metabolism of thyroid hormone, and protects from oxidative damages and infections DNA synthesis	Non-Veg: Fish, red meat, chicken, liver, Dairy: eggs Spices: garlic Grains: Whole grains of wheat, ragi
Calcium	bone structure formation	Vegetables: curry leaves, methi, green leafy vegetables, spinach, mushroom Grains: Ragi, horse gram, and breakfast cereals, soybeans, Dairy: paneer, milk, yoghurt & cheese Nuts: almonds, and apricots Fruits: oranges
Iron	Formation of haemoglobin	Vegetable: Curry leaves, radish leaves, methi greens, spinach, green leafy vegetables, beans, Lentils: Kala chana, bajra, soybean, pulses, and cereals Non-Veg: Meat and meat products, Dairy: eggs, tofu, bread, fruits Fruits: Bananas, apple, pear
For iron absorption, intake of vitamin C rich fruits/vegetables together with or post the meal should be taken. Also, tea should be avoided for at least an hour before and one hour post the meal which contains iron. Vitamin C sources help in improving iron absorption, from vegetarian sources. Therefore, squeezing few drops of lemon in the food preparations, or adding on to the tomato salad or having an amla improves absorption.		

Iodine	Required for regular metabolism of cells	Others: Iodized salt, Vegetables: sea vegetables, soil plants are grown in iodine-rich, baked potato, seaweeds, Dairy: eggs, yoghurt, cow's milk, and cheese, Non-Veg.: Fish; shrimps,
Protein	For bone and muscle formation	Bhuna Chana, Eggs, fish, milk, peas, soybeans, chana, rajma
Additional information: Exposure to the sun, particularly in the early morning is also recommended, for the natural vitamin D.		
Second Trimester		
Phosphorus	Helps in strengthening the bones and teeth, and aids in proteins that the body needs for repairing cells	Dairy foods: Curd, cheese, butter, milk Non-Veg.: Red or white meat Cereals: Most of the whole grains
Vitamin C	Aids in collagen formation which is a structural protein that helps in cell repair and helps in the formation of cartilage, tendons, bones, and skin	Fruits: papaya, citrus fruits (oranges, grapefruits, lemons), guavas, strawberries, pineapple, kiwi, litchi, amla Vegetables: mustard greens, dark green vegetables (spinach, cabbage), bell peppers, broccoli, Pak Choy, pumpkin, cauliflower, tomatoes
Calcium	Gives bones rigidity and strength to pregnant women and helps n bone formation of the fetus	Dairy Products: Eggs, Milk, buttermilk, cheese and curd Cereals: flours of cereals Vegetables: Cabbage, Kale, okra, spinach Non-Veg.: Fish – sardines and pilchards

Magnesium	Aids in strengthening the bones and also helps in easing the cramps in the expectant mother	Cereals: wheat bran, bran flakes, beans, oatmeal soybeans, legumes, Nuts: groundnuts, roasted chana, dried nariyal Seeds: pumpkin, sunflower Vegetables: Dra leafy greens Fruits: Bananas, peaches, litchis, plums Non-Veg.: Salmon, halibut
Omega-3 fatty acids	for the development of the nervous system and the brain	Legumes, grains, nuts, seeds, Vegetables: green leafy vegetables, Vegetable oils: soybean, corn, safflower, sunflower and sesame.
Third Trimester		
Vitamin A	visual health, immune function and fetal growth and development	Vegetables: Bathua, methi, spinach, carrot, tomato, sweet potato, coriander leaves, mint Fruits: mango, musk melon, dried dates
Vitamin K	Helps in blood clotting	Vegetables: Green leafy vegetables, kale, spinach, cabbage, cauliflower, broccoli Fruits: avocado, banana. Dairy products: eggs, Meat: beef liver Most of the Cereals
B complex	Helps in the metabolism of carbohydrates and supports fetal development	Dairy products: Milk, egg yolk, Meat: liver, kidney, meat, Seafood, fish Cereals: whole grain cereals, whole bread, leafy greens Fruits: bananas, Avacados

Folate	Help the placenta and baby grow	Sprouted chana, urad dal, rajma, palak, tomato soup, corn, eggs, orange, peas, carrots, lentils, Black beans, Okra, cauliflower Asparagus and spinach, Salad greens, mustard greens, kidney beans and chickpeas, Bread made with enriched wheat flour or enriched cornmeal
Omega 3	Helps in fetus brain growth and development	Meat Products: Fish Seeds: Soybeans, mustard seeds Dairy Products: Eggs, Vegetables; Spinach, Cauliflower
Calcium	Aids in strengthening the bones and teeth rigidity	Dairy Products: Curd, raita, milk, Vegetables: Dark leafy green vegetables, Meat Products: Fish
Zinc	Helps fetus to grow and develop normally; aids in wound healing Helps in cell growth and aids the creation of fetus genetic makeup	Cereals: Maize, Ragi, Wheat Meat Products: fish, lamb, beef Dairy Products: curd, buttermilk, milk Vegetables: beans, baked beans Nuts: groundnuts, almonds, peanuts, roasted chana

5.15 Outcome Parameters:

The outcome will be determined through clinical parameters, and other biochemical parameters and their correlation with anthropometric parameters.

Table 4: Outcome Parameter for women and child

Outcome table for Mother	Outcome table for New-Born
Haemoglobin concentration in women in proportion with Anemia	Anthropometry (Length, Weight, MUAC and Head circumference)
Micronutrients assessed will include Serum albumin, Serum Ferritin	*Micronutrients assessed will include* Haemoglobin, *Serum albumin, Serum Ferritin*
	Gut microbiome composition (in a sub-sample)

→ Serum ferritin at birth will reflect the iron stores in the infant and the effect of maternal supplementation on infant iron stores.

→ Gut microbiome analysis is proposed under the assumption that maternal nutritional supplementation will affect infant which in turn will affect gut microbiota composition and favour growth of Bifidobacterium species

**Bifidobacterium has been linked to improved growth*

Measures:

Scoring on Nutritional Status Assessment: The overall nutritional status assessment includes dietary assessment, anthropometric, and biochemical levels of women and child.

Anthropometric Measurements:

i. **Pregnant Women:** Pregnant women will be weighed and measured in triplicate at enrolment and measurement of the body mass index (BMI), will be calculated. Subjects will be weighed at conception and after delivery of the child.

ii. **Infant**: Infant birth weight, length at birth, Mid Upper Arm Circumference and head circumference; and other neonatal characteristics (gestational age, etc.) will be determined at birth through hospital visit.

The birth weight will be assessed on the criteria based on the national guidelines for low birth weight babies. The birth weight will be adapted to Z-scores and standard percentiles based on WHO growth and development standards and with the national guidelines for low birth weight babies.

Biochemical levels:

iii. **Pregnant Women micronutrient status:** Pregnant women venous blood draws will be done by a phlebotomist at enrolment, and post-delivery. The serological levels of Iron status will be determined by measuring haemoglobin, and ferritin, serum folate.

iv. **Infant micronutrient status:** The serological levels of haemoglobin, serum ferritin, folic acid, will be determined through cord blood

Dietary Assessment:

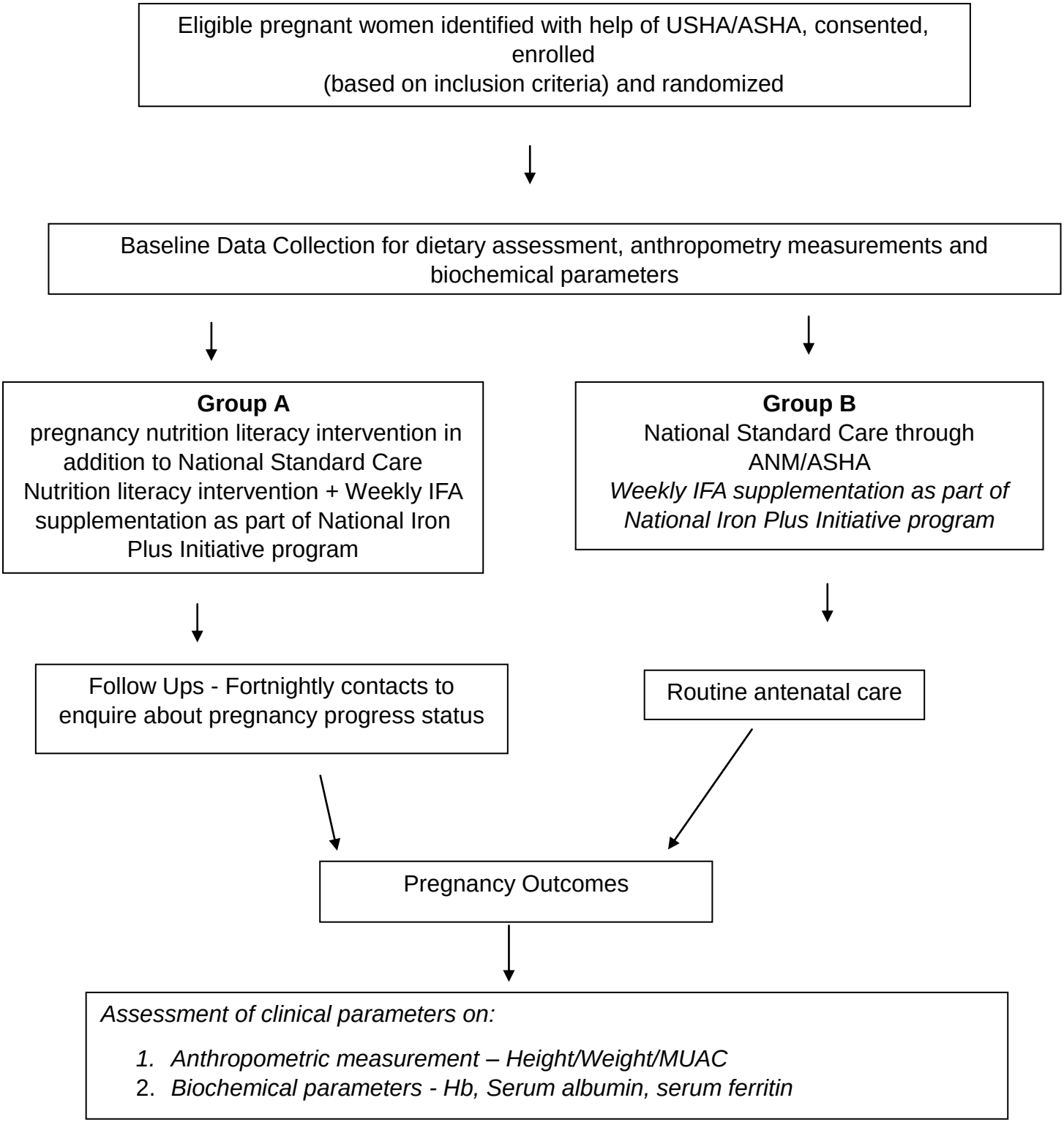
The dietary pattern of the pregnant will be recorded. It will be by the 24-hour dietary recall method. A 24-hour dietary recall method will be done through the interview method.

The respondent is asked about every food item and drinks or beverages consumed by them during the last 24 hours. The time and quantity of the intake are also noted carefully. Other details like the method of preparation of food etc. are also noted.

The respondent is gotten some information about all food things and beverages devoured by them over the most recent 24 hours. The time and amount of the admission are additionally noted cautiously. Different subtleties like the strategy for the arrangement of food and so forth are additionally noted.

This method would give a comprehensive idea about the food habit of the individual. The questionnaire would have open-ended questions and shall take around 45 – 60 mins.

Figure 6: Flow Chart of Methodology


Eligible pregnant women identified with help of USHA/ASHA, consented, enrolled
(based on inclusion criteria) and randomized
Baseline Data Collection for dietary assessment, anthropometry measurements and biochemical parameters
Group A
pregnancy nutrition literacy intervention in addition to National Standard Care
Nutrition literacy intervention + Weekly IFA supplementation as part of National Iron Plus Initiative program
Group B
National Standard Care through ANM/ASHA
Weekly IFA supplementation as part of National Iron Plus Initiative program
Follow Ups - Fortnightly contacts to enquire about pregnancy progress status
Routine antenatal care
Pregnancy Outcomes
Assessment of clinical parameters on:
1. Anthropometric measurement – Height/Weight/MUAC
2. Biochemical parameters - Hb, Serum albumin, serum ferritin

6. Expected Outcome of the research

- → The primary outcome targeted by this intervention trial is promoting a trimester-specific package of healthy accessible, affordable food items in diet consumption by increasing the variety and proportion of foods consumed for appropriate and adequate weight gain through sufficient and balanced food.
- → The secondary outcome will be awareness and nutrition literacy by improving the knowledge of pregnant women for consistent use of balanced food throughout pregnancy.
- → The study findings will suggest, that improving the trimester-specific diet quality and diversity through the dissemination of nutrition knowledge will improve associations between nutrient concentrations in pregnancy and pregnancy outcomes.

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Annexure A

Informed Consent Form

I appreciate for taking the time to talk with me today, regarding my study plan.

I am **Arshi Mehboob**, a research scholar in the Nutrition and Dietetics Department under the **Faculty of Allied Health Sciences** at Manav Rachna International Institute of Research & Studies.
Herein I am requesting your consent to join and participate in my research "Impact of trimester-specific nutrition literacy on the birth outcome of migrant pregnant women from urban slums" as a part of the fulfilment of Doctor of Philosophy (PhD) degree.

The purpose of the study is to examine the relationship of trimester-specific nutrition intake in pregnant women with anthropometric measures in birth outcomes. Towards my study, I intend to conduct a survey to learn about the nutritional intake of households with pregnant women in food items consumed in this area and impart trimester-specific nutrition knowledge.

I do not seek any risk involved in the said study, if you approve the participation, at any time you can choose to stop or skip/avoid any questions you would prefer not to reply.

With your consent for participation in the study, the first step in a survey interview includes the inquiries on topics like your family background, household activities, and consumption and food habits as well as other demographic and household characteristics.
Besides, I will also be asking for information about the way you purchase and cook your food. These inquiries in absolute will roughly take about one-two hour to finish and your interest and participation are voluntary. Your answers will be entirely classified or confidential; I won't share any data or information that distinguishes you with anybody. I would like to potentially re-contact you through ASHA for intervention and follow up.

Your answers will be entirely private and will remain classified; I won't share any data or information that recognizes you with anybody. All data provided in this questionnaire through this survey will be destroyed after 10 years.

I will likewise meet and survey other households' units within your community and other parts of NCT Delhi and NCR. After I collect the necessary requisite information and will use the data or information to assess the potential of a community program to increase low-cost food and diet diversity for the pregnant ladies for better birth outcome in your and nearby areas.

Do you have any concerns about the questions or the study or what I have said?

Should you have any inquiries concerning the research study or investigation or about the interview questions, or any concerns or grievances I encourage you to contact Ms Arshi Mehboob, by dialling +91 98997 78360. Moreover, you can contact the head of Institutional Review Board (IRB), XXX at xxxxx, +91 00000 00000.

I will give a one duplicate copy of this survey questionnaire with you so that you will also have a record of your inputs, my contact details and basics regarding the study.
I, once more confirm your agreement to the participation and involvement in the research study.
Tick option blanks:
Respondent: Yes _____ No.

I _____, agree to participate voluntarily in this field of research. All my questions have been answered satisfactorily and the risk involved has been exposed to me. I reserve my right to withdraw at any point from research without giving any reason. I have contact no. Ms Arshi Mehboob to enquire any further information from her.

Signature of Participant Signature of Researcher
Date Arshi Mehboob

Faculty of Allied Health Sciences

Manav Rachna International Institute of Research & Studies

Annexure B

Enrolment Questionnaire

Name	
Household Identification Number	
ID/Aadhar No.	
Age (in years)	
Marital status	
Primary language spoken	
Women / Household Mobile No.	
Address	
Pregnancy Reported	

Women @ Enrolment

Clinical	Hb - Anemic		Reported Illness		Diagnosis	
Nutrition	Food Consumption		Socio-economic		Demographic	
Anthropometry Measures	Weight (Kgs)		Height (cm)		Body Mass Index (BMI)	
Lifestyle	Physical Activity(ies)		Alcohol/Substance Consumption		Smoking	

Child @ Birth

Term Birth/ Pre-term Birth								
Clinical								
Anthropometry Measures	Weight		Height		MUAC		Head Circumference	

Annexure C

Survey Questionnaire

The questionnaire is designed to record/ document the socio-economic status, decision making powers and food and consumption patterns of the study participants i.e. pregnant women. Respondents shall answer the questions as accurately they can.

Listing of Survey Modules:

Module A - Basic Household Identification & Demographic Information

Module B - Diet Diversity & Consumption Information

Module C - MDDW

MODULE A - HOUSEHOLD AND INFORMATION

Basic Household Identification & Demographic Information

A.1	Census number	
A.2	HH location/landmark	
A.3	Area (name and code)	
A.4	Thana/Chauki (name and code)	
A.5	District (name and code)	
A.6	Household ethnic group	
A.7	Religion	
A.8	Which social group do you belong to? **1.** General; **2.** Scheduled caste (SC); **3.** Scheduled Tribe (ST); **4.** Other backward castes (OBC); **5.** Other, please specify	
A.9	How long have you been in Delhi? (years)	
A.10	What is [NAME] current main occupation? ***Codes**: **1.** Wage labour; **2**. Salaried worker; **3.** Self-employment; **4.** Trader; **5.** Production; **6.** Farming; **7.** Non-earning occupation; **8.** Not applicable [young child]; **9.** Don't know; **10.** Unemployed; **11.** Retired; **12.** Disabled*	
A.11	What is [NAME] secondary occupation? If any.	
A.12	Do you also work for livelihood?	

A.13	Does [NAME] attend school?	
A.14	Can [NAME] read and /or write	
A.15	What is the highest level of qualification that <<you>> have finished?	
Decision Making		
A.16	Who in your household decides against the purchase of food items, vegetables and fruits? ***1.** Household Head**; 2.** partner (husband/wife); **3.** Both; **4**. Others*	
A.17	On average, how much money do you spend on food items per week (7 days)?	
A.18	On average, how many meals a day do you cook per week (7 days)?	
A.19	From **1** (strongly disagree) - **5** (strongly agree), how much does each of the following impacts your decision to purchase food items (FOOD ITEM)?	
A.19 (a)	Affordability – I can afford to buy FOOD ITEMS	
A.19 (b)	Availability – The FOOD ITEMS I want are available to buy	
A.19 (c)	Accessibility – I can go to a place that sells FOOD ITEMs	
A.19 (d)	Taste (Peculiarity)	
A.19 (e)	Easiness to prepare/cook	
A.19 (f)	Knowledge to prepare FOOD ITEM	
A.19 (g)	Food safety of FOOD ITEM	
A.19 (h)	Proximity – the store/place being near you	
A.20	Please let us know how important you believe **that nutritional food items** are for each of the following: ***1.** Not Important**; 2.** Somewhat Important; **3.** OK, /So-So; **4.** Important; **5.** Very Important*	
A.20 (a)	For improving your family health	
A.20 (b)	For good health and nutrition	
A.20 (c)	For your body	

A.20 (d)	For your eyes and bones	
A.20 (e)	For providing nutrients which your body needs	
A.20 (f)	For enhancing immunity/body fighting against diseases	
Dwelling or Household characteristics		
A.21	**Observe ONLY (NOT TO ASK) –** Rooftop material (outer covering) ***Type of roof: 1.*** *Tiles;* ***2.*** *Wooden;* ***3.*** *Some Corrugated Metal;* ***4.*** *Plastic sheathing;* ***5.*** *Thatched/Crop matter/ sticks/small bamboos;* ***6.*** *Mud (Kaccha);* ***7.*** *Other – specify*	
A.22	**Observe ONLY (NOT TO ASK) -** Floor material ***Type of floor: 1.*** *Earthen/mud;* ***2.*** *Concrete/flag stoned/cemented;* ***3.*** *Tiles/bricks****; 4.*** *Wooded;* ***5.*** *sand mixed dung;* ***6.*** *Other (specify)*	
A.23	**Observe ONLY (NOT TO ASK) -** Exterior walls: ***Type of walls: 1.*** *Earthen/mud;* ***2.*** *Concrete/flag stoned/cemented;* ***3.*** *Tiles/bricks****; 4.*** *Wooded;* ***5.*** *sand mixed dung;* ***6.*** *Other (specify)*	
A.24	How many rooms or partitions are there in the respective household? *(Outside open area, bathrooms, galleries, toilet, and kitchen will not be counted)*	
A.25	What is the household's main source of drinking water? ***1.*** *Piped Tap Water in the house****; 2.*** *Piped Tap water into the plot;* ***3.*** *Government/ Public Tapped water;* ***5.*** *Covered dug well;* ***6.*** *Covered/walled spring;* ***7.*** *Unprotected dug well;* ***8.*** Water Tankers*;* ***9.*** *Canned water;* ***10.*** *Other (specify)*	
A.26	What is the household's main type of toilet? ***Type of toilets: 1.*** *Shared, Flush;* ***2.*** *Private, Flush;* ***3.*** *Pit latrines - Ventilated;* ***4.*** *Community toilest;* ***5.*** *Mug/Pot/bucket;* ***6.*** *Open Defecation;* ***7.*** *Other (specify)*	

A.27	Does the household have proper electricity connections? *1 - Yes; 0 - No*	
A.28	What is the basic source of household cooking fuel? ***1.** Electricity; **2.** Piped or liquid propane gas (biogas); **3.** Kerosene Oil; **4.** Charcoal**; 5.** Firewood; **6.** Animal dung; **7.** Agricultural crop residue; **8.** Other (specify)*	
CONSUMPTION INFORMATION		
Interaction: Furthermore, I would like to request you to recount each and everything that you had eaten or drank since yesterday, during the day and night, regardless of you ate it at home or elsewhere. I might want to demand you to portray each and all that you had eaten or drank since yesterday during the day and night, paying little mind to you ate it at home or somewhere else. I am keen to know about the other food items, whether they were combined with other foods. I request you to include all food items and beverages and drinks, any snacks or small meals, as well as any main courses. I would request you to mention all foods you may have eaten while preparing full meals or preparing food items for other family members. For instance, I would request you to mention the ingredients of your meal like Dalia/ khichdi with added beans, carrots, potatoes or meat. However, if broth/stock or soup was only consumed, but not the non-vegetables or the vegetables, please specify/mention that the meat or the vegetable were not added. As I request you about foods and drinks, please consider all foods and drinks you had as snacks or small meals as well as during any main course meals. Please also remember foods you may have eaten while preparing meals or preparing food for others. Please do not include any food used in a small amount for seasoning or condiments (like chillies, spices, herbs or powders). I would request you to mention those foods separately.		
Let's start with the first food or drink consumed yesterday:		
A.29	What did you eat or drink today later in the morning? If yes, please mention? Have you had eaten or drink anything else?	
A.30	What did you eat or drink today at the mid-day? If yes,	

	please mention? Have you had eaten or drink anything else?			
A.31	What did you eat or drink today in the afternoon? If yes, please mention? Have you had eaten or drink anything else?			
A.32	What did you eat in the evening? If yes, please mention? Have you had eaten or drink anything else?			
A.33	What did you eat or drink last night in the evening before going to bed or during the night? If yes, please mention? Have you had eaten or drink anything else?			
A.34	What you usually have on special days?			
A.35	Do you eat from a common pot?			
S. No.	**Food Categories**	**Description/examples to be adapted** **Unit of measure:** kg: 1; grams: 2 litre: 3; portion/unit: 4	**"Meal", "Snack" Or "Main Meal"**	**Consumed** **Yes = 1** **No= 0**
What did you eat or drink, during the yesterday day or last night?				
A	**Foods made from cereals or grains** *Read examples:* wheat, rice, millet, sorghum, or any other grains or food items made from these cereals (e.g. bread, poori, porridge, roti chapati, rolls, daliya, kheer or other grain products)	Dalia, Khichdi, roti, poha, upma, bread, boiled rice, or other foods made from grains, white roots, tubers, or plantains		

B	**White roots and tubers and plantains** *Read examples:* carbohydrate-rich non-colored items including all non-grain starchy staples	White potatoes, white-fleshed sweet potato white yams, cassava, or other white-fleshed roots or tubers, or plantains foods		
C	**Pulses (beans, lentils and peas)** *Read examples:* beans, peas, lentils, or meals made from these	Beans or peas (fresh or dried seed), lentils products, pulses (beans, peas and lentils)		
D	**Nuts and seeds** *Read examples:* Groundnut, Almond, Cashew, Pistachio, Walnut	Any tree nuts, groundnut, peanut or nut/seed “butter” or pastes Nuts and seeds		
E	**Milk and milk (Dairy) products** *Read examples:* milk, cheese, yoghurt or other milk products	Milk, cheese, yoghurt or other milk products but non-inclusive of butter, ice cream, cream or sour cream		
F	**Organ meat** *Read examples:* beef, mutton, chicken, pork, lamb, rabbit, duck, kidney, or other birds’ liver, heart or other organ meats or blood-	Liver, kidney, heart or other organ meats or other non-vegetarian foods		

	based foods			
G	**Meat and poultry**	Beef, pork, lamb, mutton, rabbit, wild game meat, chicken, duck or other bird		
H	**Fish and other seafood**	Fresh or dried fish, shellfish or seafood		
I	**Eggs** *Read examples:* chicken, duck, or any other egg	Chicken / Duck Eggs from poultry farms or other bird eggs		
J	**Dark Green Leafy Vegetables (GLVs)** *Read examples:* Orange fleshed vegetables like carrots, pumpkin, squash, or sweet potatoes	Examples of seasonal green leafy vegetables, including wild/ foraged leaves		
K	**Vitamin A-rich vegetables, roots and tubers** *Read examples:* musk melon, red pepper, ripened mangoes, fresh or dried apricots, ripened papaya, dried peaches	Sweet potatoes, carrots, pumpkin, or other yellow or orange-fleshed, amaranth (red or green), spinach and yellow maize		
L	**Vitamin A-rich Fruits (including wild fruits)**	Ripened mango, ripened papaya, musk melon, watermelon		

M	**Other edible vegetables** *Read examples:* onion, tomato, mustard leaves collard greens, basella, fenugreek leaves, local greens, eggplant or any other vegetable, including wild vegetables	Mention names of other vegetables		
N	**Other edible fruits**	Mention names of other vegetables		
Other food categories				
What did you eat or drink, during the yesterday day or last night?				
S. No.	**Food Categories**	**Description/ examples to be adapted**	**"Meal", "Snack" Or "Main Meal"**	**Consumed Yes ~ 1 No ~ 0**
O	**Insects and other small protein foods**	Bugs, Beetles, Flies larvae/ grubs, eggs and land and marine snails		
P	**Red palm oil**	Refined red palm oil		
Q	**Other crude/ raw or refined oils and fats**	Oil; fats or butter/ ghee added to food or used for cooking		
R	**Savories and deep-fried snacks**	Fried or baked dough Meethi pooris and chips		
S	**Sweets**	Delicacies such as		

		laddus, candies, cookies/ sweet biscuits and cakes, sweet halwa or ice creams		
T	**Sweetened / Sugared beverages**	Canned Fruit Juices, soft drinks, fizzy drinks, malt drinks, chocolate drinks, sweetened buttermilk, sweet curd or tea or coffee with sugar		
U	**Spices and local herbs for flavor**	Spices or condiments used for essence, such as chillies, elaichi, Cinnamon, other herbs, dried fish powder, garlic, dried ginger, tomato paste, flavour cubes or seeds		
V	**Other beverages, drinks or liquids**	Tea, kahwa, clear stocks/broths/soups, alcohol pickles		
What did you eat or drink, during the yesterday day or last night?				
*For every single eating episode, the respondent references for the foods and drinks, the respondent will be queried further as to whether she ate or drank anything else. If the respondent references a mixed platter like gravy or mixed vegetables, the ingredients of the mixed dish will be recorded. To pick out the ingredients from the mixed dishes, as to understand whether the respondent herself ate the full meal or if only had the gravy probing will continue until she says “no, nothing else”.				

				Annexure D
Parameters				
Mother		**-**	**Child**	
Anthropometric Measurement				
Components	**Values**		**Components**	**Values**
Height (cm)			Height (cm)	
Weight (Kgs)			Weight (Kgs)	
Body Mass Index (BMI)			Mid Upper Arm Circumference (cm)	
			Head Circumference (cm)	
Haematological Levels				
Haemoglobin			Haemoglobin	
Serum Ferritin			Serum Ferritin	
Serum Folate			Serum Folate	
			Gut Microbiome	